11th World Conference on Earthquake Engineering, Jun. 23-28, 1996, Acapulco, Mexico

AN EXPERIMENTAL STUDY ON SHEAR FAILURE MECHANISM OF RC INTERIOR BEAM-COLUMN JOINTS

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RC earthquake-resistant frames are designed on "strong-column weak-beam" concept. Besides, shear failure of beam-column joint should be avoided, before the adequate ductile behavior of frames is obtained. Whereas a number of researches on joint shear failure were carried out, the equation for the joint shear strength has not been established. Joint shear failure occurs when the shear stress level is large, but it is different on the condition with or without adjacent beam yielding. The two experimental studies about joint shear failure with/without beam yielding were carried out. The results showed that: 1) if beam yielding did not occur, shear strength was equal in spite of the different in joint reinforcement volume. 2) joint shear failure resulted from the compressive fracture of joint concrete, in both conditions of with/without beam yielding. 3) joint reinforcement made a large influence on the joint shear strength if adjacent beams yielded.

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SHEAR FAILURE OF REINFORCED CONCRETE BEAMS SUBJECTED TO DIAGONAL TENSION

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In most of all previous studies on shear behavior of reinforced concrete beams, beams were tested on condition that shear force were generated by compressive loading. The diagonal compression field is dominant in the shear resistance of such loading condition, so concrete would be significant in the shear resistance. The reinforced concrete beams subjected to shear on condition that diagonal tension was dominant behaved different in shear cracking strength, ultimate shear strength and stress transfer mechanism, from those in diagonal compression field. In particular, there was the remarkable reduction in shear cracking strength of almost

30% from the past proposed equation that was derived from the compressive loading tests. The shear transfer mechanism in RC beams is depended on the loading type. If shear forces are generated by tension, the truss mechanism becomes significant in shear resistance, because concrete diagonal compressive strut would not be formed apparently.

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ANCHORAGE BEHAVIOR OF 90-DEGREE HOOKED BEAM BARS IN REINFORCED CONCRETE BEAM-COLUMN JOINTS

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In the previous paper, the authors classified the anchorage failure of 90-degree hooked bars in beam-column joints into three modes: a side split failure, a local compression failure and a raking-out failure. The last one is an anchorage failure as a concrete block inside a L-shape bar layer is raked out toward to the beam side caused by providing many beam bars and/or short development length in the joint. The purpose of this paper is to establish an anchorage strength evaluation for the raking-out failure mode of 90-degree bar bend in a beam-column joint, on the basis of experiments. The conclusions are 1) the strength increased severely according to increase of column axial stress in range of the axial stress ratio less than about one third, 2) since the failure crack lines with a trapezoidal shape in horizontal cross section appeared, the effect of lateral joint reinforcement on the strength reduced in case of large thickness of cover concrete.

5th International Conference
on Air Distribution in Rooms
RoomVent'96 YOKOHAMA
July 17-19, 1996

A Feasibility Study on Passive Ventilation in Airtight Houses in Cold Regions

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A passive ventilation system in Hokkaido is not spread at present. This report presents the concept and the housing system to the airtight performance for the passive ventilation, so two subjects are discussed.

The first subject is the changes in the ventilation rate and the permissible level of change. Changes in the ventilation rate caused by a stack effect were measured in an airtight test house from autumn to winter by tracer gas techniques. It was found that the effect of changes of wind velocity on changes in the ventilation rate was smaller than the effect of temperature difference between inside and outside. The passive ventilation system in the airtight test house was able to supply the required amount of fresh air in winter when the temperature difference between inside and outside was large.

The second subject is the appropriate installation of an inlet for fresh air and the best method for circulating air in occupant spaces. As the temperature of outdoor air is very low in winter, the fresh air coming into the house must be warmed. The buffer space under the floor maybe used as a chamber to warm the cold outdoor air and to distribute the warmed fresh air. Such a ventilation system in homes in cold regions can greatly improve the indoor environment.

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The Analysis Accuracy of Multiple Tracer Gas Techniques for Measuring Interzonal Airflows

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Multiple tracer gas techniques for measuring interzonal airflow rates between zones in a multizone building involve the sampling and measurement of the concentration of each tracer gas in each zone. Continuous concentration measurements in each zone are usually not practical, discrete sampling and measurement with one instrument for each gas are the typical approach used.

Two methods, a differential method and an integral method, are commonly used to calculate the interzonal airflows from the measured tracer gas concentrations. A previous study by the authors indicated that both methods would give similar results when the data obtained under well controlled laboratory conditions were used. As the tracer gas concentrations measured under field conditions, are often not as accurate as those measured under laboratory conditions, a further comparison of these methods was made to determine their accuracies under field applications. This paper presents the results.

The 7th International Conference on Indoor Air Quality and Climate, Indoor Air '96
July 21-26, 1996 NAGOYA, JAPAN

A Simplified Numerical Simulation for Estimating the Temperature Distribution in Atrium Spaces

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This paper presents a numerical simulation method for calculating the air temperature profiles in a large stairwell space. An atrium, such a stairwell space, is divided into five imaginary zones, stratified horizontally. Buoyant convection flows are formed by the surface temperature under the boundary layer of vertical walls. The cool outdoor air through the high

side openings flows into the imaginary zones according to the vertical distribution of air temperature caused by the buoyant convection flows. A numerical analysis method comprising the heat balance of five imaginary zones and each wall surface, and from the balance of airflow rates is proposed as a convenient analytical method for estimating the air and wall surface temperature distribution and the temperature distributions. The temperature profiles simulated by the proposed method were very close to the measured profiles in the actual atrium space.

The 5th International Conference on SEISMIC ZONATION October 17-19, 1995, Nice FRANCE

SEISMIC ZONATION MAPS OF SAPPORO METROPOLITAN AREA, NORTHERN JAPAN, DERIVED FROM DENSE QUESTIONNAIRE SURVEYS OF SEISMIC INTENSITY

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The authors conducted high precision questionnaire surveys to investigates seismic intensity distribution in Sapporo Metropolitan area, Northern Japan after the two major earthquakes which hit Hokkaido, in 1993. Intensity evaluation was done in square segmental units of 500×500 m distributing more than 6,000 questionnaires for each earthquake and these values were plotted on the maps using GIS program on PC. Local site effects were extracted eliminating intensity attenuation due to epicentral distance and discussed in relation with soil conditions. As a nonlinearity was found in the estimated intensity deviations by soil type, an empirical model for evaluating seismic intensity for future earthquakes was composed adopting a neural network data processing.

The 11th World Conference
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MEXICO

SEISMIC HAZARD MAPS OF HOKKAIDO, JAPAN, BASED ON THE DATA OF QUESTIONNAIRE INTENSITY SURVEYS

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A method for making seismic hazard maps was proposed by use of intensity distributions surveyed densely and precisely. Seismic hazard maps indicating distributions of seismic input motions for future expecting earthquakes are fundamental data for regional disaster mitigation problems and in the case of wider region including many municipalities an uniformed method covering the whole area is required.

As for an example, Hokkaido island, northern most of Japan was chosen and a simplified method based on observational data was proposed. In order to make hazard maps an application of actual seismic intensity distribution data was introduced. We have been conducted seismic intensity surveys using questionnaire method and have been accumulated detailed intensity distributions of Hokkaido district since the 1982 Urakawa-oki earthquake. In the two years of 1993 and 1994 we had four big damaging earthquakes of Kushiro-oki, Hokkaido Nansei-oki, Hokkaido Toho-oki and Sanriku Haruka-oki which occurred in and around Hokkaido and seismic intensity surveys were carried out in order to get precise intensity distributions. The results of these surveys were shown and intensity database was upgraded.

Using these data, an empirical method for making intensity distribution maps for hypothetical earthquakes was developed and applied examples were shown. Characteristics of regional attenuation was also extracted from deformed isoseismals using a spatial filtering technique.

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DESCRIPTION FOR INDOOR SPACE DAMAGE DEGREE OF BUILDING IN EARTHQUAKE

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The severity of seismic damage to buildings is usually defined by assigning a damage

degree to the main structural elements, such as column, beam or load-bearing wall. However we often observed different extent of casualties in destroyed buildings of the same type that were classified as having the same damage degree. This fact induced us to consider a new index for building damage classification that is relevant to observed damage and can be universally applicable.

The resistance of various building types to earthquake loads can be defined by the use of " Vulnerability analysis ". The vulnerability of a building is one of the principal factors affecting the occurrence of casualties in earthquakes. Nevertheless past experience has shown that the probability of casualty occurrence depends very much on the loss of indoor space in affected buildings. The former should be called " Structural vulnerability analysis " while the latter can be called " Space vulnerability analysis ". In order to progress the analyses, space vulnerability function (W-Function) by which indoor space damage degree in a destroyed building unit can be estimated is proposed in this paper. This function is constructed by 4 indices Wi (i=1 to 4), that is, W1 describes the space loss in plan of building, W2 describes the space loss in section, W3 describes the volume loss of survival space, and W4 describes the amount of dust.

Examples were given as values of W-function for selected building types based on analysis of a photographic database of collapsed buildings in some Chinese earthquakes. As a result of this analysis, it was found out that W-function method could systematically described structural damage pattern characterized by building types. Casualty in a building is more associated with indoor space deterioration than with collapse of main structural elements of building. It would become important to estimate indoor space damage degree by such an approach proposed in this paper.

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SEISMIC MICROZONATION OF COASTAL HILLSIDE CITY — A CASE STUDY IN OTARU, HOKKAIDO, JAPAN —

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In Japan there have been a lot of studies on seismic microzonation, however, the majority of them are of metropolitan areas which have wide sedimentary plain, for instance Tokyo, Nagoya and Osaka. However, there are many hillside coastal cities in Japan. Seismic zonation in coastal hillside city has many more considerable problems than in city on flat land, for example, landslide, difficulty of evacuation. The city of Otaru, Hokkaido is chosen as a test field. The city of Otaru is formed on three steps marine terrace, with many slopes. In addition there are a lot of vulnerable historical buildings.

The database of many information of Otaru, such as geological, social, and past earth-

quakes, was constructed. After 1993 Kushiro-oki earthquake and 1993 Hokkaido Nansei-oki, intensity surveys were conducted using the questionnaire method in order to estimate intensity in details. About past earthquakes, the damages were picked up with newspapers of those days. Microtremor measurements were carried out on the ground to understand the characteristics of ground motion. The data from microtremor measurements, the boring data, and intensity distribution, were compiled and distribution maps of these data were shown with GIS method.

Undulations map were made and it shown that a lot of undulations were distributed in residential areas. In two intensity distribution maps, the higher altitude became, the smaller intensity became. Past earthquake damage distributions shown some damages concentrate on around area in which soft deposits soil distribute. Natural periods of the ground recorded in microtremor measurements were approximate to the natural periods calculated from S-wave velocity and depth of the deposits with boring data. Landslide distribution map was also shown. Historical buildings were classified into 4 groups in terms of structures, and these distributions were shown. It shown that a lot of timber frame masonry buildings were located near tourist attractions.

This study were developed in Otaru, and with using of regional characteristics it will be able to apply to all of many hillside cities. The seismic zonation map must be made immediately so that it can be applied to the community and urban planning of hillside cities.